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(54) **PORTABLE IN-THE-VEHICLE ROAD SIMULATOR**

TRAGBARER FAHRZEUGINTERNER STRASSENSIMULATOR

SIMULATEUR DE ROUTE EMBARQUE PORTABLE

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EP 1 495 434 B1

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Description

BACKGROUND OF THE INVENTION

[0001] As public roads are becoming more and more congested, there is an increasing need to better train drivers of motor vehicles to decrease the number of road accidents. For example, one of the major causes of accidents, especially among younger drivers, is their inability to recognize a dangerous road situation due to the obstructed line-of-sight and path-of-travel. It is often very time consuming to train students to recognize dangerous road situations during the actual behind-the-wheel driving session. Such situations do not present themselves in a repeatable, consistent manner to each student driver. There are significant time gaps between their occurrences, which have a very large margin of error, causing a student to make unnoticed mistakes frequently. Unnoticed driving mistakes, in turn, cause the students to develop bad driving skills.

[0002] It is also very difficult to train drivers in hazardous road conditions without compromising the safety of the driver. Examples of such hazardous road conditions may include slippery roads, over-speeding on sharp turns, etc.

[0003] Training through driving simulation generally addresses the above issues.

[0004] A variety of solutions to the above-identified problem have dealt with simulation driving experiences. Those solutions broadly fall into two categories: (1) modifications of stock vehicles to simulate hazardous road conditions, and (2) complete computer-based simulated driving environments not involving a real vehicle.

[0005] Modifications of stock vehicles usually call for a dedicated vehicle to be used only for training, which cannot be otherwise used for driving. Simulation of the hazardous road conditions in such dedicated vehicles usually provides realistic haptic and motion feedback, while the spectrum of simulated experiences is limited mostly to tire skids.

[0006] Computer-based simulated driving environments, while providing the most training benefits, require a dedicated maintained floor space. They also frequently require a real car cabin to be used to achieve a high enough degree of realism of the simulation. When the kind of a training vehicle needs to be changed, the changing procedure usually calls for a cabin replacement, which is very costly and time consuming.

[0007] Both of the above-described categories also do not allow a driver to get the advantageous training inside the driver's own vehicle.

[0008] The German Patent Application DE 199 28 490 A1 discloses an arrangement for equipping a roadway vehicle as a driving simulator. The front wheels of the vehicle are driven on to turntables which have ramps formed on both sides thereof. The arrangement has a computer for computing vehicle dynamics, an image of the surroundings and driving noise, a display system for displaying the image, a loudspeaker for reproducing the noise and sensors for detecting the position of the pedals, hand levers and the tracking angle of the front wheels.

[0009] The present invention is defined by the independent claims and addresses the need to provide portability and realistic feel of driving an actual vehicle while not exposing the driver to the real hazardous road situation during training. The system of the present invention can be quickly set-up and used in any available parking space.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

[0010]

Fig. 1 is a general view of a portable system with an actual vehicle.

Fig. 2 is high-level block diagram of a simulator.

Fig. 3 is schematic illustration of sensors and interfaces for reading a real-time state of the vehicle's controls.

Fig. 4 is a schematic illustration of a digital interface between a vehicle's controls and on- board sensors.

Fig. 5 is schematic illustration of audio-visual output devices.

Fig. 6 is a schematic illustration of actuators.

Fig. 7 is a schematic illustration of a simulation engine software and courseware running on a computer.

DESCRIPTION OF THE INVENTION

[0011] Turning now to Fig. 1, shown there is a portable system for driving simulation coupled with an actual vehicle. In operation, a driver/trainee uses an actual vehicle to drive up on a two-piece ramp 2; the two-piece ramp 2 being positioned under turntables 3. It should be appreciated that the driver can use any actual vehicle, including his or her own vehicle to receive the desired training. The choice of a vehicle provide the driver with an advantage to receive training in and get used to the vehicle that the driver will be actually driving after completing the training program. It should also be noted that the terms "driver", "student", "user" and "trainee" are used throughout this description interchangeably.

[0012] After the vehicle is positioned on the two-piece ramp 2, the engine of the vehicle is tuned off. Steered wheels 1, controlled by the vehicle's steering wheel, located inside the cabin, are placed and optionally locked on top of the turntables 3. Each turntable 3 can rotate around its own vertical axis, following the steering movements of the steered wheels 1.

[0013] While the vehicle is immobile and its power steering is not active, turntables 3 allow the driver/trainee to operate the steering wheel of the vehicle without applying excessive force, which would have been necessary on the actual road due to the friction between the steered wheels and the surface of the road while the vehicle is immobile. The steering wheel must be unlocked during the operation of the portable system of the present invention while the engine of the vehicle is turned off. In most vehicles turning off is accomplished by turning the key in the ignition of the vehicle without starting the engine. If a real-time force-feedback effect to the steering wheel is desired to be provided to the driver, the effect can be provided by optional steering actuators 61 located inside the turntables 3. Since the engine of the vehicle is not running during the simulation, the power steering is not active. To compensate for this lack of the actual power steering, smaller-than-natural forces can be applied to the steered wheels 1 of the vehicle by the steering actuators 61 in order to generate the realistic feedback.

[0014] Regardless whether the steering actuators 61 are present in the portable simulation system, the steering wheel returns to its central position driven by the natural forces resulting from exerting the weight of the vehicle to the Steering Angle Inclination (SAI) of the steered wheels 1. If the steering actuators 61 are used, the force returning the steering wheel to its central position depends on the simulated speed of the vehicle and is defined by the simulation software.

[0015] An optional steering sensor 39 (shown in Fig. 3) is used to generate information about a position of the steering wheel in order to generate corresponding simulated view of the road. The optional steering sensor 39 should be used when the vehicle's own built-in steering sensor is not available.

[0016] Inside the vehicle an optional brake pedal sensor and actuator can be positioned under a brake pedal 34 (also shown in Fig. 3). An optional gas pedal sensor can be positioned under a gas pedal 35 (also shown in Fig. 3). The optional brake pedal sensor and the optional gas pedal sensor should be used when the vehicle's own built-in brake pedal and gas pedal sensors are not available. For practical reasons both brake pedal and gas pedal sensors can be mounted in a single enclosure. As shown in Fig. 6, an optional actuator 63 coupled to the brake pedal 34 can be used to simulate an anti-lock brake (ABS) pulsation.

[0017] Fig. 2 shows a high-level block diagram of the portable simulator. As shown in Fig. 2, computing means 22 receive input data from non-invasive means for reading real-time state of the vehicle controls 21. A portable computer, such as a notebook computer having built-in 3D graphics processor can be used as computing means. The computer processes the input data and generates a Virtual Driving Environment (VDE) to be provided to the driver using audio and visual means 24. Audio and visual means normally consist of a Head-Mounted Display (HMD) and a set of headphones. Alternatively, other forms of portable displays can be employed, such as LCD screens pasted on the inside of the vehicle's windows, as well as a set of external speakers might be used. The VDE is presented to the driver in the field of view corresponding to the head orientation of the driver provided by the head tracker 25. To improve the fidelity of the simulation, the computer 22 controls an optional plurality of actuators 23, shown in further detail in Fig.6, comprising a steering actuator 61, a motion feedback cushion 62 and an ABS pulsation actuator 63.

[0018] Shown in Fig. 7 is a schematic representation of the software for simulating a VDE running on the computing means 22. In the preferred embodiment the software is running on a portable computer powered by the battery of the vehicle or by the computer's own battery, therefore eliminating the need in an external power source. The portable computer is controlled by a Simulation Engine Software 72, processing the real-time state data from various vehicle controls, described further below. The Simulation Engine Software 72 processes the data from the head tracking sensor 25 (shown in Fig. 2) to generate an appropriate graphical representation of the VDE on the screen(s) of a Head Mounting Display 4 (HMD) as shown in Fig. 1. The Simulation Engine Software 72 is normally designed and maintained by software engineers. It provides an intermediate language for driver educators and researchers to describe a variety of road situations, or "scenarios", having an educational value.

[0019] Courseware Components 71, shown in Fig. 7, comprise driving lessons and "scenarios" created by the driving educators and researchers, who generally do not have a background in software engineering. Different Courseware Components can be designed by different organizations. They can be put together in sequences to design the desired curriculum.

[0020] The portable computer also comprises a sound processor that generates audio signals to enhance the representation of the VDE and communicate verbal instructions to the driver via headphones 52, shown in Fig. 5, frequently built into the HMD.

[0021] In order to reduce what is known to be "simulation sickness" sometimes resulting from the mismatch of the visual cues and the physical body cues, the driver can use an optional motion feedback cushion 62 shown in Fig.6. Motion feedback cushions of the type commonly used in computer games usually comprise a set of low-frequency power speakers pushed against a person's back to apply vibrations to the person's body. An undesirable effect of the "simulation sickness" can be reduced by applying variations of the vibration patterns reflecting the changes in the driving conditions in the VDE. An optional brake pedal ABS-pulsation actuator 63 can be used to provide the simulated effect of operating an Anti-Lock Brake System.

[0022] Simulating operation of a vehicle using an actual vehicle can be accomplished by placing a pair of turntables 3 under the steered wheels 1 of the vehicle, as shown in Fig. 1, to relieve the friction of the steered

wheels of the actual vehicle with a road surface. Placing the turntables under the steered wheels makes it possible for the steered wheels to be steered freely while the vehicle is immobile, enabling the actual vehicle's steering to be operated by a user without using excessive force. The method further comprises providing computing means 22 reading the real-time data of the state of the vehicle's controls to simulate a Virtual Driving Environment (VDE).The computing means is preferably a portable computer with a Simulation Engine Software. The software receives an input of the real-time data from the head tracking sensor 25, mounted on the HMD. The head tracking sensor communicates the exact orientation of the driver's head to the computer, so that the appropriate field of view of the VDE can be generated by the computer and displayed to the driver. In other words, using all of the above-described data, the computer generates a graphical representation of the VDE at the current orientation of the driver's head and displays the graphical representation by the portable audio and visual means to the driver. An audio output may contain, but is not limited to, an engine noise, traffic noise, and audio instructions.

[0023] Also in accordance with the present invention a method of training of a student driver can be accomplished by using an actual vehicle while it is immobilized to allow the student driver sitting in the vehicle to use the vehicle's steering wheel to drive through the Virtual Driving Environment (VDE). Driving through the VDE, simulated by the computer and audio-visual means, provides rich simulated driving experience to the student driver. The experience can comprise encountering simulated real life-like road dangers and practicing avoidance skills. The student driver can also safely practice risk assessment skills during the driving simulation. Optional other Computer Based Training (CBT) means can be employed between the driving lessons. The CBT means can be any educational activities performed outside of a simulated driving lesson. The CBT means can include, but are not limited to, short fragments of a video presented to the student driver, followed by a commentary and a series of questions. A combination of the simulated driving activities with non-simulated CBT can be used to promote development and maintenance of the long-term driving skills. Driving through the VDE, simulated by the computer using audio and visual means capable of providing immediate feedback to the student driver, enhances the effectiveness of driver training. Training of the student driver is usually accomplished by using a curriculum comprising a series of driving lessons by repeating the above-described steps as many times as deemed desirable. A typical length of a lesson can be 10 to 15 minutes each.

[0024] Also, in accordance with the present invention a method of assessing driver's skills in the actual immobilized vehicle can be performed by using the actual vehicle, such as the driver's own vehicle, and presenting the driver with the simulated driving experience by driving through the Virtual Driving Environment (VDE). The driving simulation is accomplished by a computer and audio and visual means. While the driver drives through the VDE, measurements of the driver's performance characteristics can be taken.

Claims

1. A portable system for simulating operation of a vehicle using an actual vehicle, the portable system comprising:

   means for relieving the friction of steered wheels (1) of the actual vehicle with a road surface, enabling the actual vehicle's steering to be operated without using excessive force while the actual vehicle is immobile, wherein the means for relieving the friction comprise a two-piece ramp (2) with turntables (3) positioned under the steered wheels;
   computing means (22) for simulating a Virtual Driving Environment (VDE); audio and visual means (24) for presenting the computer-generated VDE to a user;
   and non-invasive means for reading a real-time state of a plurality of vehicle's controls configured to send data to said computing means;
   characterized in that,
   the two-piece ramp (2) is positioned under the turntables (3);
   the audio and visual means (24) is a wearable Head Mounted Display (HMD); and
   a Head Tracking Sensor for indicating the current position of the user's head relative to the computing means (22) to generate a field of view of the VDE, and head phones (52) coupled to the HMD or to a plurality of external speakers.

2. The portable system of Claim 1, wherein the actual vehicle is a car, a truck or a van.

3. The portable system of Claim 1, wherein the means for reading comprise an OBD II data bus or other standard interface to on-board sensors of the actual vehicle.

4. The portable system of Claim 1, wherein the means for reading comprise a plurality of sensors including a steering sensor (39), gas pedal (35) and brake pedal (34) sensors.

5. The portable system of Claim 4, wherein the plurality of sensors is selected from the groups consisting of a gear shift sensor, including a transfer case control sensor, a differential control sensor, a PTO control sensor, a clutch pedal sensor, a turn signal switch sensor or a plurality of turn signal photo sensors, a parking brake sensor, a seat belt sensor and com-

binations thereof.

6. The portable system of Claim 1, wherein the computing means (22) is a computer operated by software comprising:

a Simulation Engine Software (72) component for processing signals from the plurality of sensors and generating an output image and sound; and
a plurality of Courseware Software components (71), each of the components implementing a particular driving lesson in the VDE.

7. The portable system of Claim 1, further comprising a Brake pedal ABS-pulsation actuator providing the simulated anti-lock braking sensation to the user's foot.

8. The portable system of Claim 1, further comprising a Steering actuator (61) to provide a real-time force-feedback to the user.

9. The portable system of Claim 1, further comprising a motion feedback cushion providing physical body cues.

10. A method of simulating operation of a vehicle using an actual vehicle comprising the steps of:

a user driving the actual vehicle on a two-piece ramp (2) with turntables (3);
relieving the friction of steered wheels (1) of the actual vehicle with a road surface with the two-piece ramp (2) and the turntables (3) positioned under the steered wheels (1); the two-piece ramp (2) being positioned under the turntables (3); enabling the actual vehicle's steering to be operated by the user;
providing computing means (22) simulated a virtual driving environment (VDE); using real-time state of actual vehicle's controls as input for the computing means simulating the VDE; and
computing means (22) generating output to the user using portable audio and visual means (24), wherein the audio and visual means (24) is a wearable Head Mounted Display (HMD) (4); and indicating with a Head Tracking Sensor a current position of the user's head relative to the computing means (22) to generate a field of view of the VDE, and wherein head phones are coupled to the HMD or to a plurality of external speakers.

11. The method as recited in Claim 10, wherein said steps are for training driver and/or assessing driver's skills.

12. The method as recited in Claim 10 or 11, wherein the user is using a series of lessons to develop driving skills by repeating the steps.

13. The method as recited in Claim 12, wherein the user is using the series of lessons further comprises using Computer Based Training means.

14. The method as recited in Claims 10 to 13, wherein the user is a driver to be trained or a driver to be assessed in his skills.

15. The method as recited in Claims 10 to 14, wherein the actual vehicle is provided by the driver.

Patentansprüche

1. Transportables System zum Simulieren des Betriebs eines Fahrzeugs mithilfe eines tatsächlichen Fahrzeugs, wobei das transportable System Folgendes umfasst:

Mittel zum Aufheben der Reibung von gelenkten Rädern (1) des tatsächlichen Fahrzeugs mit einer Straßenoberfläche, was ermöglicht, dass das Lenken des tatsächlichen Fahrzeugs ohne übermäßige Kraft erfolgt, während das tatsächliche Fahrzeug unbeweglich ist, wobei die Mittel zum Aufheben der Reibung eine zweiteilige Rampe (2) mit Drehscheiben (3) umfassen, die unter den gelenkten Rädern positioniert sind;
Rechenmittel (22) zum Simulieren einer virtuellen Fahrumgebung (VDE); audio-visuelle Mittel (24) zum Präsentieren der computergenerierten VDE für einen Benutzer;
und nicht-invasive Mittel zum Ablesen eines Echtzeitstatus einer Vielzahl von Fahrzeugsteuerungen, die dafür ausgelegt sind, Daten an die Rechenmittel zu senden;
dadurch gekennzeichnet, dass
die zweiteilige Rampe (2) unter den Drehscheiben (3) positioniert ist;
das audio-visuelle Mittel (24) eine tragbare, am Kopf montierte Anzeige (HMD) ist; und
einen Kopfverfolgungssensor zum Angeben der aktuellen Position des Kopfs des Benutzers relativ zu den Rechenmitteln (22), um ein Sichtfeld der VDE zu erzeugen, und Kopfhörer (52), die mit der HMD oder einer Vielzahl von externen Lautsprechern gekoppelt sind.

2. Transportables System nach Anspruch 1, wobei das tatsächliche Fahrzeug ein Personenkraftwagen, ein Lastkraftwagen oder ein Lieferwagen ist.

3. Transportables System nach Anspruch 1, wobei die Mittel zum Ablesen einen OBD-II-Datenbus oder eine andere Standard-Schnittstelle mit bordeigenen

Sensoren des tatsächlichen Fahrzeugs umfassen.

4. Transportables System nach Anspruch 1, wobei die Mittel zum Ablesen eine Vielzahl von Sensoren, einschließlich eines Lenksensors (39) sowie Sensoren für das Gaspedal (35) und das Bremspedal (34), umfassen.

5. Transportables System nach Anspruch 4, wobei die Vielzahl von Sensoren aus den Gruppen bestehend aus einem Gangschaltsensor, einschließlich eines Verteilergetriebesteuerungssensors, eines Differenzialsteuerungssensors, eines Zapfwellensteuerungssensors, eines Kupplungspedalsensors, eines Blinkerschaltersensors oder einer Vielzahl von Blinker-Lichtsensoren, eines Parkbremsensors, eines Sicherheitsgurtsensors und Kombinationen davon, ausgewählt ist.

6. Transportables System nach Anspruch 1, wobei das Rechenmittel (22) ein Computer ist, der durch eine Software betrieben wird, die Folgendes umfasst:

eine Komponente in Form einer Simulationsmaschinensoftware (72) zum Verarbeiten von Signalen von der Vielzahl von Sensoren und zum Erzeugen eines Ausgabebilds und -schalls; und eine Vielzahl von Lernsoftware-Komponenten (71), wobei jede der Komponenten eine spezielle Fahrlektion in der VDE ausführt.

7. Transportables System nach Anspruch 1, ferner umfassend einen Aktuator für die ABS-Pulsation des Bremspedals, der die simulierte Blockierschutz-Bremsempfindung für den Fuß des Benutzers bereitstellt.

8. Transportables System nach Anspruch 1, ferner umfassend einen Lenkaktuator (61) zum Bereitstellen einer Echtzeit- Kraftrückmeldung an den Benutzer.

9. Transportables System nach Anspruch 1, ferner umfassend ein Bewegungsrückmeldekissen, das physikalische Körperreize bereitstellt.

10. Verfahren zum Simulieren des Betriebs eines Fahrzeugs mithilfe eines tatsächlichen Fahrzeugs, umfassend die folgenden Schritte:

Lenken des tatsächlichen Fahrzeugs auf einer zweiteiligen Rampe (2) mit Drehscheiben (3) durch einen Benutzer;
Aufheben der Reibung der gelenkten Räder (1) des tatsächlichen Fahrzeugs mit einer Straßenoberfläche durch die zweiteilige Rampe (2) und die unter den gelenkten Rädern (1) positionierten Drehscheiben (3);
wobei die zweiteilige Rampe (2) unter den Drehscheiben (3) positioniert ist;
Ermöglichen, dass das Lenken des tatsächlichen Fahrzeugs durch den Benutzer ausgeführt wird;
Bereitstellen von Rechenmitteln (22), die eine virtuelle Fahrumgebung (VDE) simulieren;
Verwenden des Echtzeitstatus der Steuerungen des tatsächlichen Fahrzeugs als Eingabe für die Rechenmittel, welche die VDE simulieren; und
Erzeugen einer Ausgabe an den Benutzer durch die Rechenmittel (22) mithilfe eines transportierbaren audio-visuellen Mittels (24), wobei das audio-visuelle Mittel (24) eine tragbare am Kopf montierte Anzeige (HMD) (4) ist; und
Anzeigen einer aktuellen Position des Kopfs des Benutzers relativ zu den Rechenmitteln (22) mit einem Kopfverfolgungssensor, um ein Sichtfeld der VDE zu erzeugen, und
wobei Kopfhörer mit der HMD oder einer Vielzahl von externen Lautsprechern gekoppelt sind.

11. Verfahren nach Anspruch 10, wobei die Schritte zum Schulen eines Fahrers und/oder zum Beurteilen des Könnens eines Fahrers dienen.

12. Verfahren nach Anspruch 10 oder 11, wobei der Benutzer eine Serie von Lektionen anwendet, um durch das Wiederholen der Schritte Fahrkönnen zu entwickeln.

13. Verfahren nach Anspruch 12, wobei das Anwenden der Reihe von Lektionen durch den Benutzer ferner das Verwenden von computergestützten Schulungsmitteln umfasst.

14. Verfahren nach den Ansprüchen 10 bis 13, wobei es sich bei dem Benutzer um einen Fahrer, der geschult werden soll, oder um einen Fahrer, dessen Können beurteilt werden soll, handelt.

15. Verfahren nach den Ansprüchen 10 bis 14, wobei das tatsächliche Fahrzeug vom Fahrer bereitgestellt wird.

Revendications

1. Système portable destiné à simuler le fonctionnement d'un véhicule à l'aide d'un véhicule réel, lequel système portable comprend :

des moyens pour abolir le frottement des roues directrices (1) du véhicule réel sur une surface de chaussée, permettant la manoeuvre de la direction du véhicule réel sans effort excessif tandis que le véhicule réel est immobile, les moyens pour abolir le frottement comprenant une rampe

en deux parties (2) avec des plateaux tournants (3) positionnés sous les roues directrices ;
des moyens de calcul (22) pour simuler un environnement de conduite virtuel (ECV) ;
des moyens audiovisuels (24) pour présenter l'ECV généré par l'ordinateur à un utilisateur
et des moyens non invasifs pour lire un état en temps réel de plusieurs des commandes du véhicule, configurés pour envoyer des données auxdits moyens de calcul,

caractérisé en ce que la rampe en deux parties (2) est placée sous les plateaux tournants (3) ;
les moyens audiovisuels (24) sont un casque de visualisation ; et
il est prévu un capteur de suivi de la tête destiné à indiquer la position instantanée de la tête de l'utilisateur par rapport aux moyens de calcul (22) afin de générer un champ de vision de l'ECV, et des écouteurs (52) couplés au casque de visualisation ou à plusieurs haut-parleurs externes.

2. Système portable selon la revendication 1, dans lequel le véhicule réel est une voiture, un camion ou une camionnette.

3. Système portable selon la revendication 1, dans lequel les moyens de lecture comprennent un bus de données OBD II ou une autre interface standard vers les capteurs de bord du véhicule réel.

4. Système portable selon la revendication 1, dans lequel les moyens de lecture comprennent plusieurs capteurs dont un capteur de direction (39) et des capteurs de pédale d'accélérateur (35) et de pédale de frein (34).

5. Système portable selon la revendication 4, dans lequel les plusieurs capteurs sont sélectionnés dans les groupes comprenant un capteur de changement de rapport, notamment un capteur de commande de boîte de transfert, un capteur de commande de différentiel, un capteur de commande de prise de force, un capteur de pédale d'embrayage, un capteur de bouton de clignotant ou plusieurs photocapteurs de clignotant, un capteur de frein de stationnement, un capteur de ceinture de sécurité et des combinaisons de ceux-ci.

6. Système portable selon la revendication 1, dans lequel le moyen de calcul (22) est un ordinateur piloté par un logiciel et comprenant :

un composant logiciel de moteur de simulation (72) pour le traitement des signaux des plusieurs capteurs et la génération d'une image et de sons en sortie ; et
plusieurs composants de didacticiel (71) dont chacun présente une leçon de conduite donnée dans l'ECV.

7. Système portable selon la revendication 1, comprenant en outre un actionneur de pulsations d'ABS pour pédale de frein simulant la sensation de freinage antiblocage sous le pied de l'utilisateur.

8. Système portable selon la revendication 1, comprenant en outre un actionneur de direction (61) fournissant un retour de force en temps réel à l'utilisateur.

9. Système portable selon la revendication 1, comprenant en outre un coussin de retour de mouvement fournissant des indications physiques au niveau du corps.

10. Méthode de simulation du fonctionnement d'un véhicule à l'aide d'un véhicule réel comprenant les étapes suivantes :

conduite d'un véhicule réel par un utilisateur jusqu'à une rampe en deux parties (2) munie de plateaux tournants (3) ;
abolition du frottement des roues directrices (1) du véhicule réel sur une surface de chaussée avec la rampe en deux parties (2) et les plateaux tournants (3) placés sous les roues directrices (1) ;
positionnement de la rampe en deux parties (2) sous les plateaux tournants (3) ;
manoeuvre de la direction du véhicule réel par l'utilisateur ;
fourniture de moyens de calcul (22) simulant un environnement de conduite virtuel (ECV) ;
utilisation de contrôles de l'état en temps réel du véhicule réel comme entrées pour les moyens de calcul simulant l'ECV ; et
génération par les moyens de calcul (22) de sorties vers l'utilisateur à l'aide de moyens audiovisuels portables (24), les moyens audiovisuels (24) étant un casque de visualisation (4) ; et
indication avec un capteur de suivi de la tête d'une position instantanée de la tête de l'utilisateur par rapport aux moyens de calcul (22) afin de générer un champ de vision de l'ECV,
dans lequel des écouteurs sont couplés au casque de visualisation ou à plusieurs haut-parleurs externes.

11. Méthode selon la revendication 10, dans laquelle lesdites étapes sont destinées à la formation du conducteur et/ou à l'évaluation des compétences du conducteur.

12. Méthode selon la revendication 10 ou 11, dans laquelle l'utilisateur utilise une série de leçons pour acquérir des compétences de conduite en répétant

les étapes.

13. Méthode selon la revendication 12, dans laquelle l'utilisation par l'utilisateur de la série de leçons comprend l'utilisation de moyens de formation sur ordinateur.

14. Méthode selon les revendications 10 à 13, dans laquelle l'utilisateur est un conducteur à former ou un conducteur dont les compétences doivent être évaluées.

15. Méthode selon les revendications 10 à 14, dans laquelle le véhicule réel est fourni par le conducteur.

FIG. 1

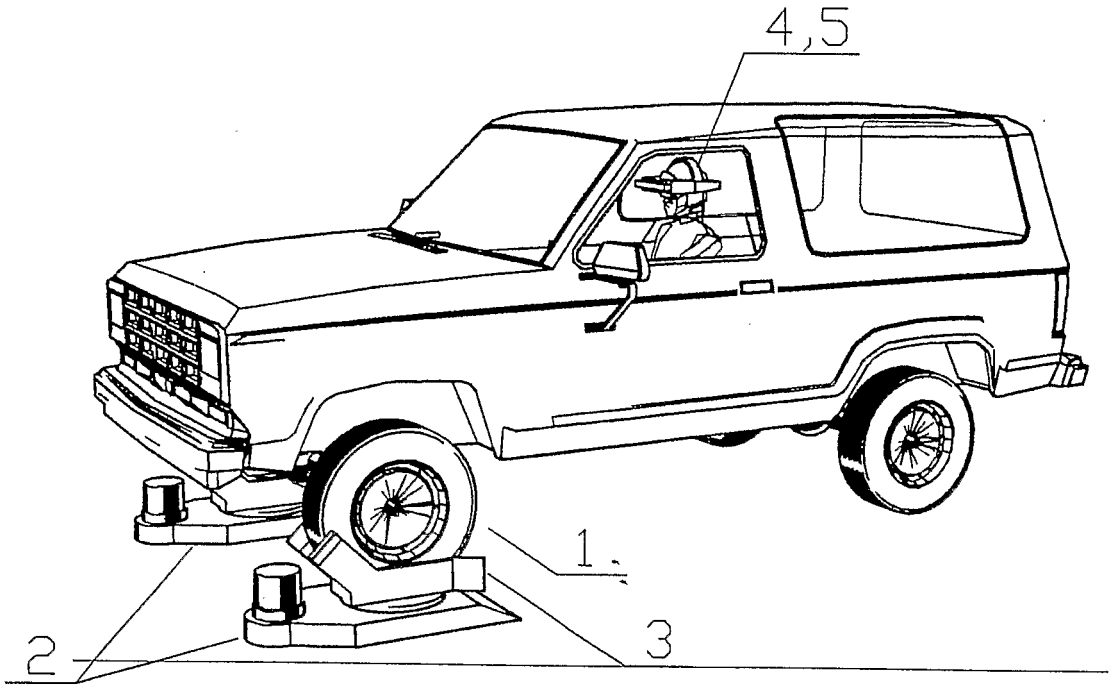


FIG. 2

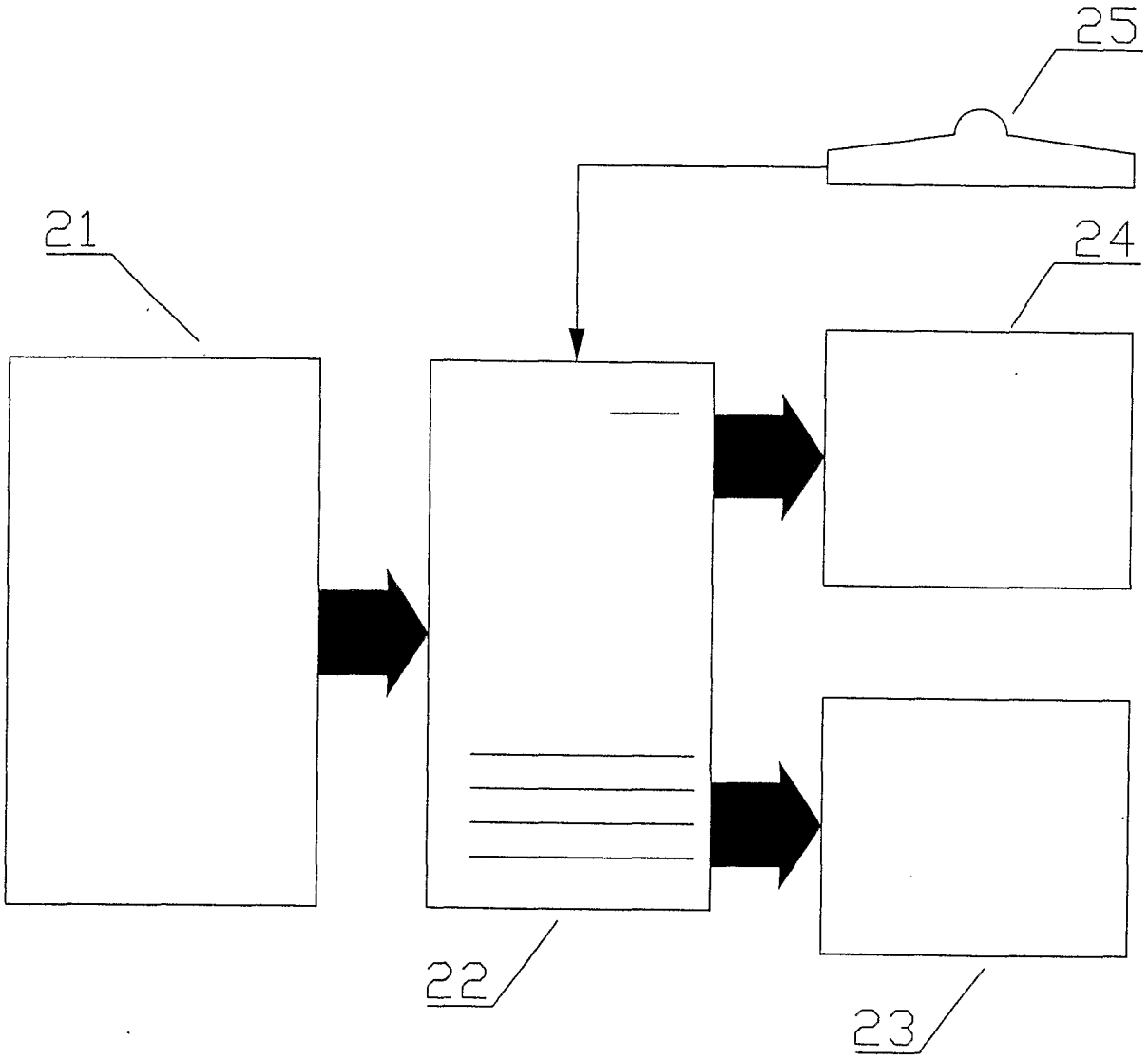


FIG. 3

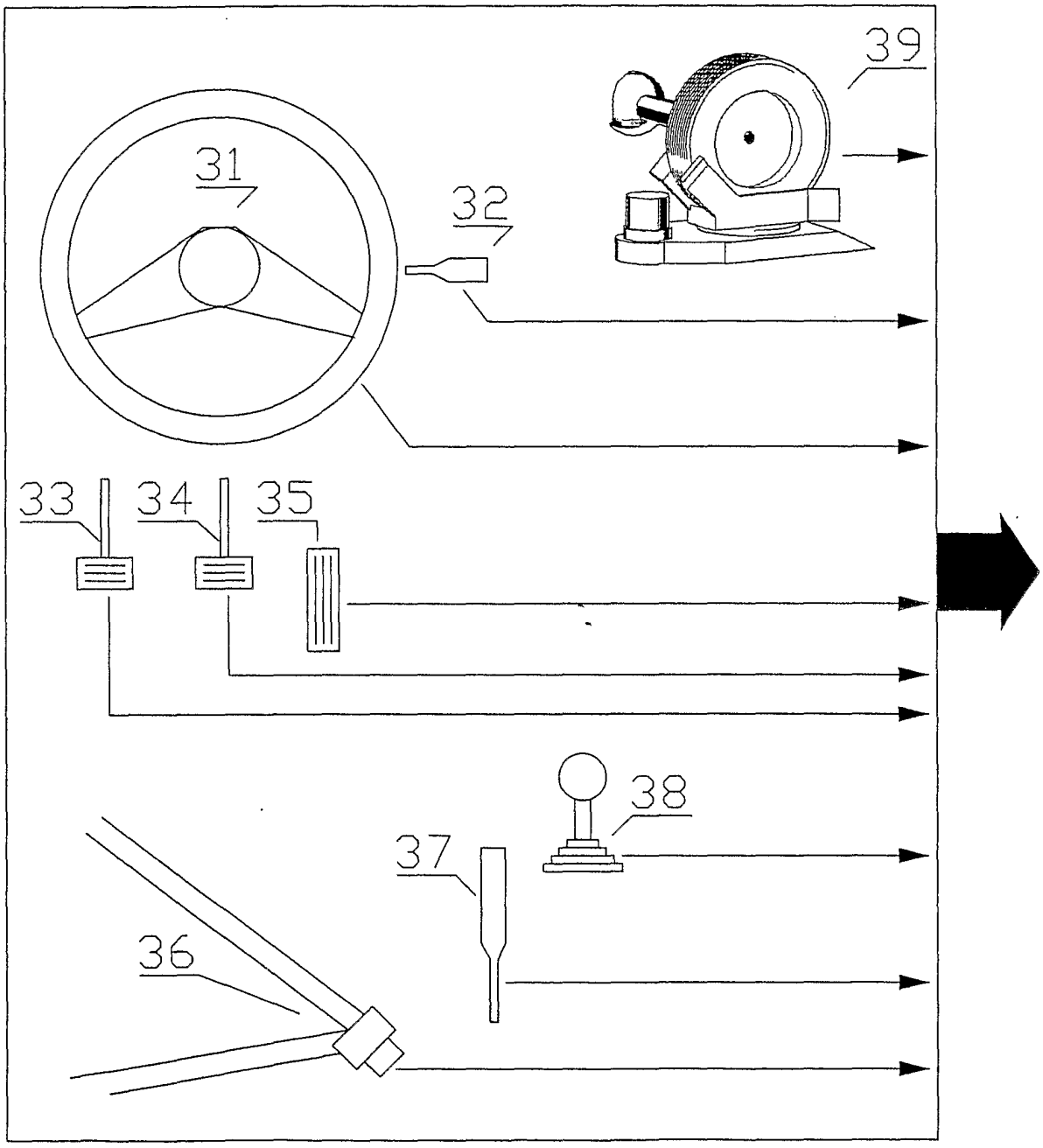


FIG. 4

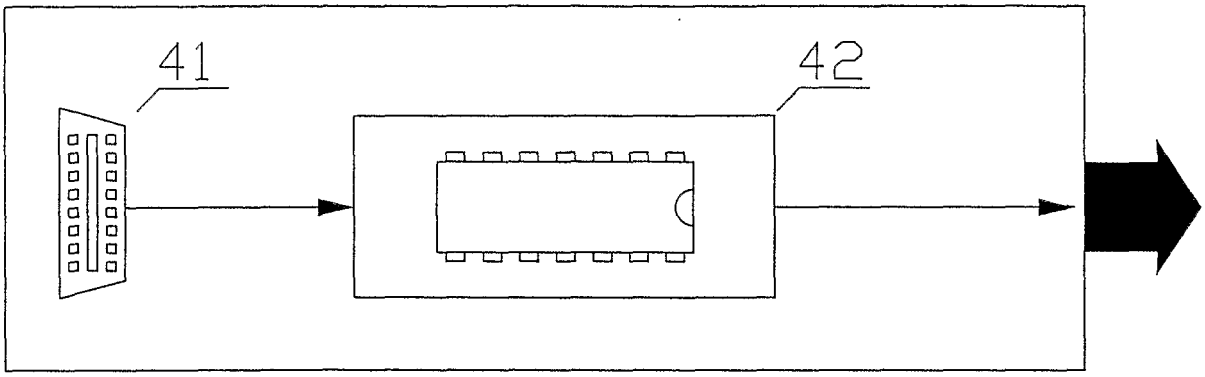


FIG. 5

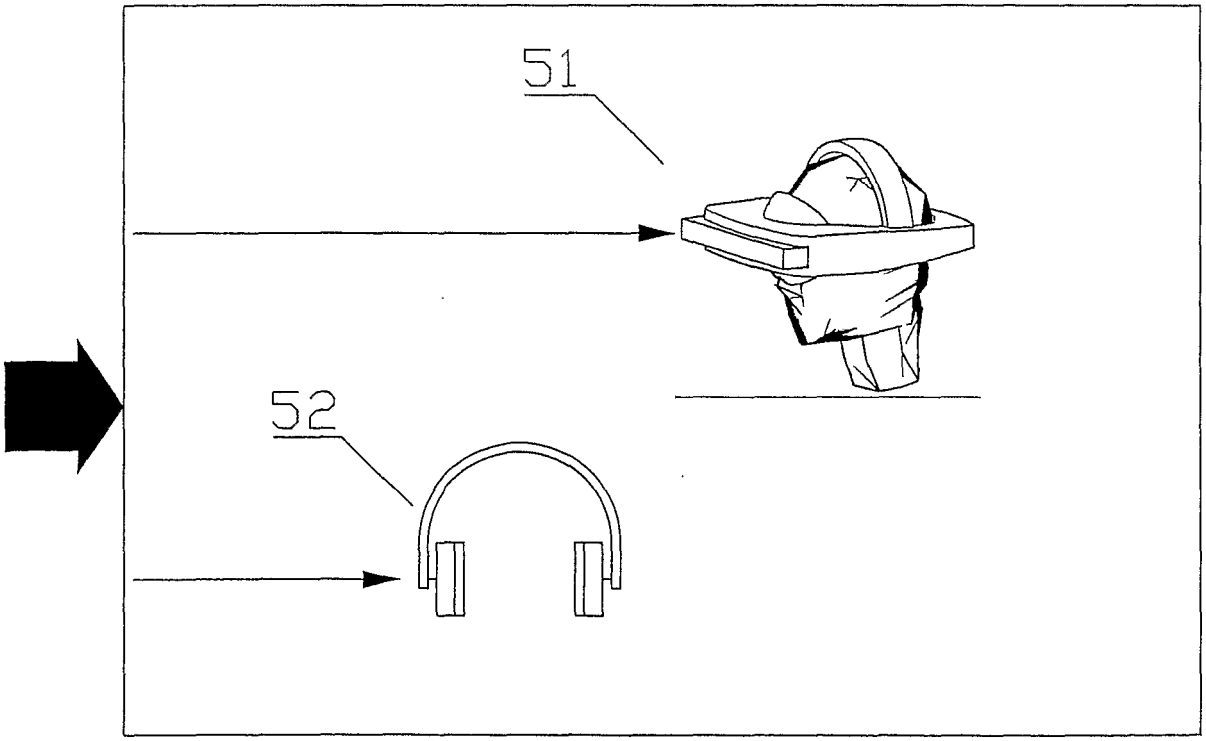


FIG. 6

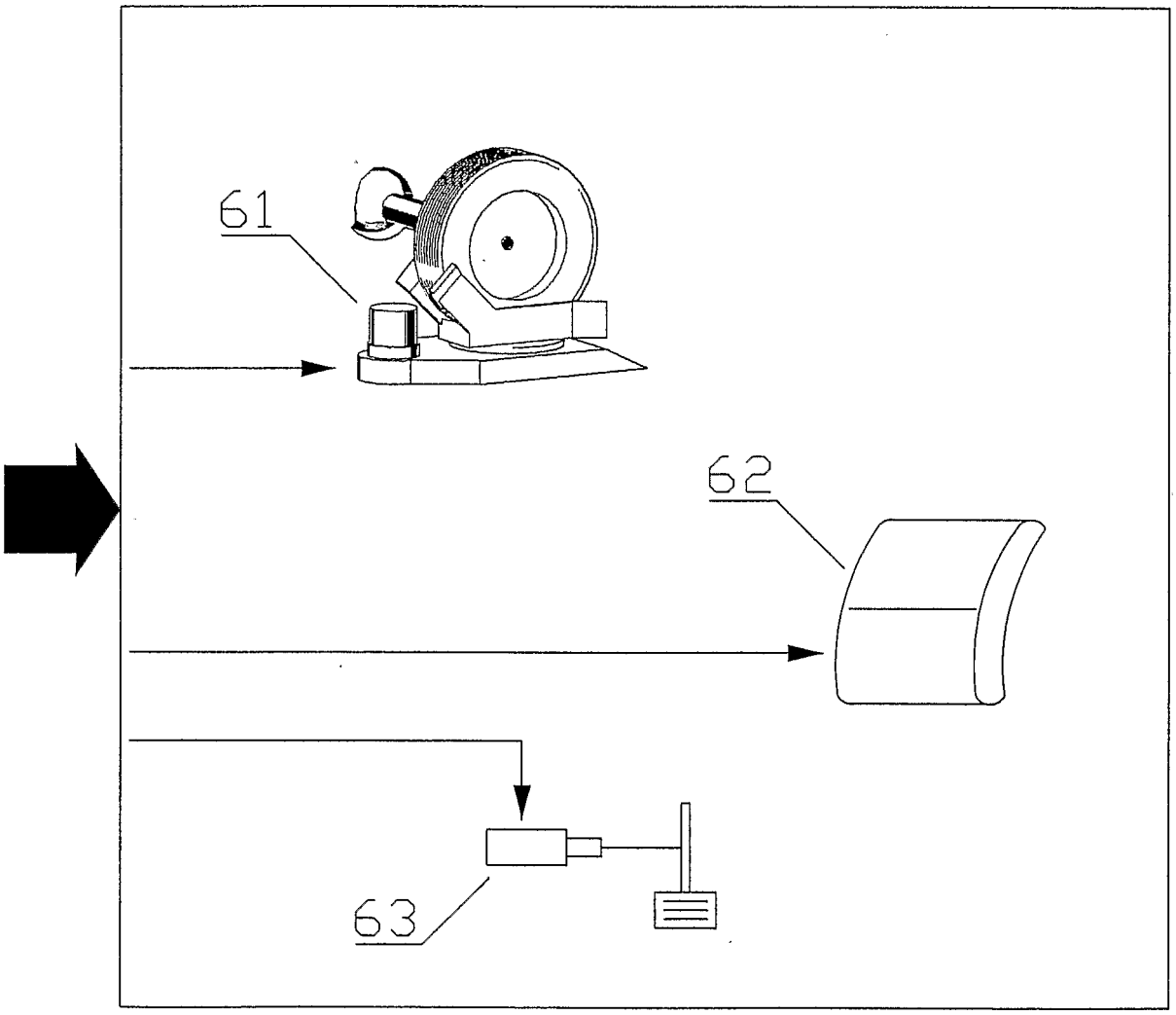
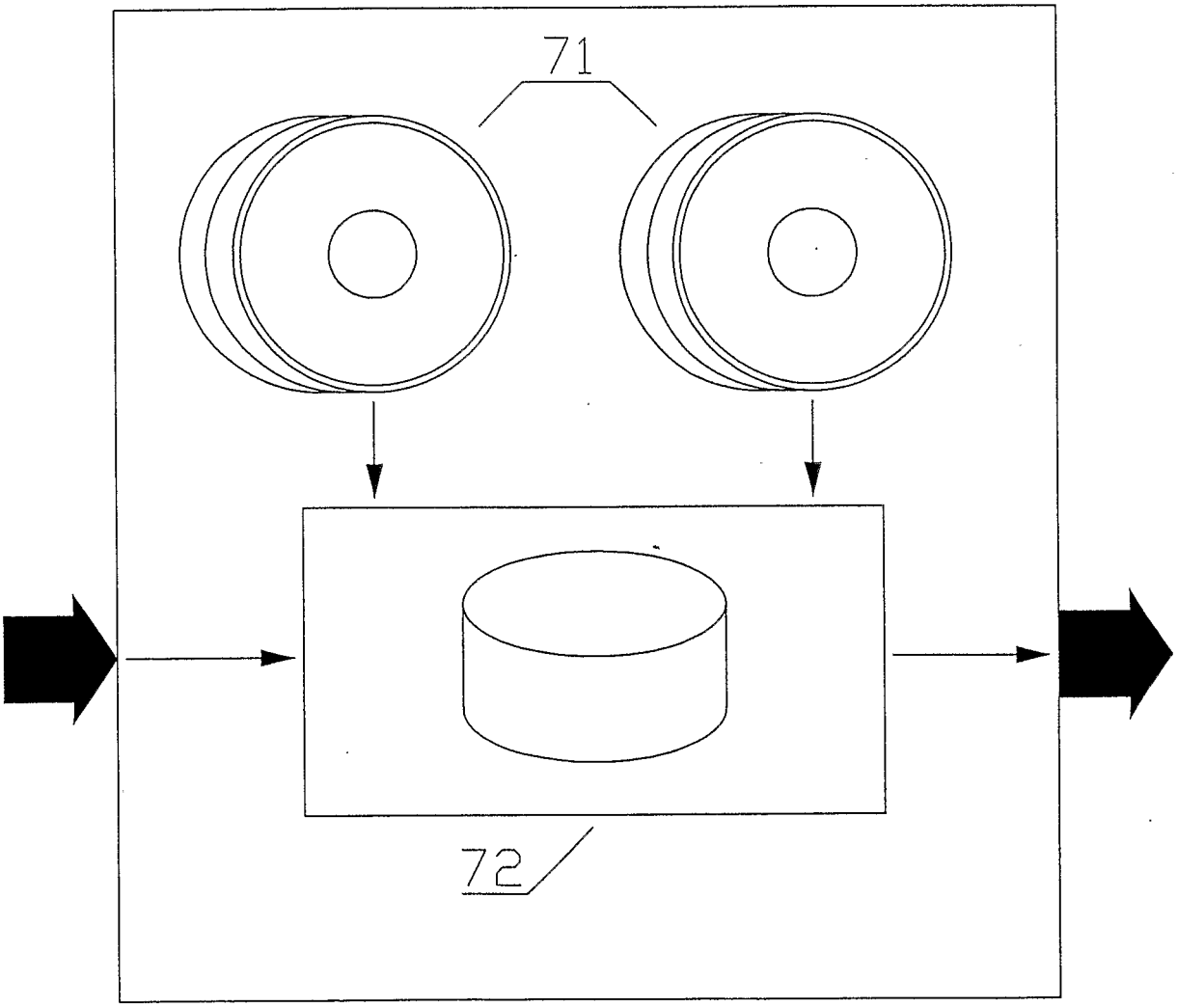


FIG. 7



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Patent documents cited in the description

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